

WHAT IS CLAIMED IS:

1. An radio frequency (RF) addressable sensor comprising:
 - one or more sensor elements;
 - a sensor interface having an analog to digital converter coupled to the one or more sensor elements;
 - at least one antenna;
 - an RF power and communication interface coupled to the at least one antenna and the sensor interface;
 - a controller coupled to the RF power and communications interface and the sensor interface; and
 - a memory coupled to the controller and the sensor interface, wherein the memory is configured to store a tag identification number;
 - wherein the RF addressable sensor communicates with a wireless device that is coupled to a communications network; and
 - wherein the wireless device communicates with the RF addressable sensor to obtain sensor data for transmission over the communications network.
2. The RF addressable sensor of claim 1, wherein the sensor interface further comprises a memory.
3. The RF addressable sensor of claim 2, wherein the memory includes a sensor data table.
4. The RF addressable sensor of claim 3, wherein the sensor data table stores a sensor identification number.
5. The RF addressable sensor of claim 3, wherein the sensor data table includes sensor processing information.
6. The RF addressable sensor of claim 5, wherein the sensor processing information includes software for analyzing the sensor data.

7. The RF addressable sensor of claim 2, wherein the memory is a programmable memory.
8. The RF addressable sensor of claim 1 further comprising one or more reference elements.
9. The RF addressable sensor of claim 1, wherein the RF power and communications interface, memory and sensor interface are implemented in an integrated circuit.
10. The RF addressable sensor of claim 9, wherein at least one of the one or more sensor elements are implemented in the integrated circuit.
11. The RF addressable sensor of claim 9, wherein the integrated circuit and the at least one antenna are on a substrate.
12. The RF addressable sensor of claim 11, wherein at least one of the one or more sensor elements is implemented on the substrate.
13. The RF addressable sensor of claim 11, wherein at least one of the one or more sensor elements is external to the substrate.
14. The RF addressable sensor of claim 1, wherein the RF addressable sensor is a micro-electrical-mechanical system.
15. The RF addressable sensor of claim 14, wherein at least one of the one or more sensor elements includes a microcantilever device.
16. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is a micro-electrical-mechanical system.

17. The RF addressable sensor of claim 16, wherein the micro-electrical-mechanical system includes a microcantilever device.
18. The RF addressable sensor of claim 1, wherein at least one of the one or more sensor elements is an antenna.
19. The RF addressable sensor of claim 1 further comprising a thermistor.
20. The RF addressable sensor of claim 1, wherein the RF power and communication interface includes a power generation module that powers the RF addressable sensor.
21. The RF addressable sensor of claim 20, wherein the power generation module includes circuitry for harvesting RF energy.
22. The RF addressable sensor of claim 20, wherein the power generation module includes a power supply.
23. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is an accelerometer.
24. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is an acoustic wave sensor.
25. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is a piezoelectric sensor.
26. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is a resistive sensor.
27. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is a field-effect sensor.

28. The RF addressable sensor of claim 13, wherein the at least one of the sensor elements external to the substrate is a nanosensor.

29. The RF addressable sensor of claim 13, wherein at least one of the sensor elements external to the substrate is coupled to an external power supply.

30. A wireless sensor reader comprising:
at least one antenna configured for communication with one or more radio frequency (RF) addressable sensors;
a controller;
a network communications module coupled to the controller, the network communications module having an interface for coupling to a communications network;
a logic module coupled to the controller; and
a user interface,
wherein the logic module includes a sensor communications module for receiving sensor data from the one or more RF addressable sensors.

31. The wireless sensor reader of claim 30, wherein the communications network is a wireless communications network.

32. The wireless sensor reader of claim 31, wherein the at least one antenna is configured for communication with the communications network.

33. The wireless sensor reader of claim 31, further comprising a network antenna configured for communication with the communications network.

34. The wireless sensor reader of claim 30, wherein the communications network is a public data network.

35. The wireless sensor reader of claim 34, wherein the interface for coupling to the communications network comprises a data communications interface.

36. The wireless sensor reader of claim 30, wherein the user interface includes a preconfigured button for initiating a read of the RF addressable sensors.

37. The wireless sensor reader of claim 30, wherein the RF addressable sensor logic module further comprises:

a sensor processor having sensor data processing logic; and
a tag processor.

38. The wireless sensor reader of claim 37, wherein the logic module further comprises a geolocation processor.

39. The wireless sensor reader of claim 38, wherein the geolocation processor comprises logic to perform at least one of GPS-based geolocation and non GPS-based geolocation.

40. The wireless sensor reader of claim 30, further comprising means for receiving sensor processing information over the communications network.

41. The wireless sensor reader of claim 40, wherein the sensor processing information includes software for analyzing sensor data.

42. The wireless sensor reader of claim 30, wherein the controller, network communications module, and user interface are implemented in a wireless communications device.

43. The wireless sensor reader of claim 42, wherein the logic module is implemented in the wireless communications device.

44. The wireless sensor reader of claim 43, wherein the at least one antenna capable of communication with the one or more RF addressable sensors is coupled to the wireless communications device.

45. The wireless sensor reader of claim 43, wherein the wireless communications device includes a programmable processor.

46. The wireless sensor reader of claim 45, wherein the logic module is software stored in the programmable processor.

47. The wireless sensor reader of claim 46, wherein the software is downloaded into the programmable processor over a data interface.

48. The wireless sensor reader of claim 47, wherein the data interface is an infrared interface.

49. The wireless sensor reader of claim 47, wherein the data interface is an air interface.

50. The wireless sensor reader of claim 47, wherein the data interface is an accessory interface.

51. The wireless sensor reader of claim 42, wherein the wireless communications device includes a data interface.

52. The wireless sensor reader of claim 51, wherein the logic module is external to the wireless device and couples to the wireless device via the data interface.

53. The wireless sensor reader of claim 51, wherein the data interface is an infrared interface.

54. The wireless sensor reader of claim 51, wherein the data interface is an accessory interface.

55. The wireless sensor reader of claim 52, wherein the at least one antenna capable of communication with the one or more RF addressable sensors is coupled to the logic module.

56. The wireless sensor reader of claim 45, wherein the wireless communications device includes an interface.

57. The wireless sensor reader of claim 56, wherein a second logic module is external to the wireless device

58. A RF addressable sensor network, comprising:
one or more RF addressable sensors;
one or more wireless sensor readers coupled to a communications network; and
one or more end user devices coupled to the communications network;
wherein the one or more wireless sensor readers communicate with the one or more RF addressable sensor to obtain sensor data for transmission over the communications network.

59. The RF addressable sensor network of claim 58, wherein the communications network includes a wireless communications network and at least one of the one or more wireless sensor readers include a wireless communications device.

60. The RF addressable sensor network of claim 58, wherein the communications network is a data network.

61. The RF addressable sensor network of claim 60, wherein the communications network further comprises a wireless communications network coupled to the data network.

62. The RF addressable sensor network of claim 60, wherein the communications network is the Internet.

63. The RF addressable sensor network of claim 58, further comprising a sensor network processor coupled to the communications network.

64. The RF addressable sensor network of claim 63, wherein the sensor network processor comprises a geolocation processor and a sensor data processor.

65. The RF addressable sensor network of claim 64 wherein the geolocation processor includes logic to perform GPS based geolocation and non-GPS based geolocation.

66. A method in a wireless sensor reader for obtaining sensor data from one or more radio frequency (RF) addressable sensors and for communicating the sensor data over a communications network, comprising:

- (a) transmitting signals to the one or more RF addressable sensors wherein the signals initialize the one or more RF addressable sensors;

- (b) interrogating the one or more RF addressable sensors to isolate an individual RF addressable sensor;

- (c) receiving sensor data from the isolated RF addressable sensor;

- (d) determining whether processing of the received sensor data is required;

- (e) if it is determined in step (d) that no processing of the received sensor data is required, displaying the sensor data at the wireless sensor reader;

- (f) if it is determined in step (d) that processing of the received sensor data is required, determining whether processing is to be performed at the wireless sensor reader;

- (g) if it is determined in step (f) that processing of the received sensor data is to be performed at the wireless sensor reader, performing the steps of:

- processing the received sensor data, and

- displaying the processed sensor data at the wireless sensor reader; and

- (h) if it is determined in step (f) that processing of the received sensor data is not to be performed at the wireless sensor reader, performing the steps of:

- communicating the received sensor data over the communications network to a network sensor processor,

receiving processed sensor data, and
displaying the processed sensor data at the wireless sensor
reader.

67. The method of claim 66, further comprising:
prior to step (a), performing the steps of:
receiving a connection signal from an end user device coupled
to the communications network;
connecting to the end user device over the communications
network; and
receiving one or more initiation signals from the end user
device.

68. The method of claim 66, wherein initiating the read of the one or more
RF addressable sensors includes automatically initiating the read on
occurrence of an event.

69. The method of claim 68, wherein the event is the passage of a
predefined period of time.

70. The method of claim 66, wherein the wireless sensor device includes a
user interface having a keypad and a display.

71. The method of claim 70, wherein initiating the read of the one or more
RF addressable sensors comprises entering a sequence of key strokes via the
keypad.

72. The method of claim 70, wherein initiating the read of the one or more
RF addressable sensors comprises activating an item on the display.

73. The method of claim 66, wherein the wireless sensor device includes a
button preconfigured to initiate a read of the one or more sensor elements.

74. The method of claim 73, wherein initiating the read of the one or more RF addressable sensors comprises pressing the preconfigured button.

75. The method of claim 66, further comprising:
prior to step (a),
receiving one or more initiation signals from an RF addressable sensor.

76. The method of claim 66, further comprising:
prior to step (a),
receiving logic for obtaining sensor data from the one or more RF addressable sensors.

77. A method in a radio frequency (RF) addressable sensor for communicating sensor data to a wireless sensor reader for transmission over a communications network, wherein the RF addressable sensor includes one or more sensor elements, comprising:

- (a) receiving signals from the wireless sensor reader;
- (b) obtaining analog sensor data from at least one sensor element;
- (c) converting the analog sensor data to digital sensor data; and
- (d) communicating the digital sensor data to the wireless sensor reader for transmission over the communications network.

78. The method of claim 77, further comprising prior to step (b) receiving a read sensor signal from the wireless sensor reader.

79. The method of claim 77, further comprising prior to step (d) processing the digital sensor data.

80. The method of claim 77, further comprising the step of communicating a stored tag identification number to the wireless sensor reader.

81. The method of claim 77, further comprising the step of communicating reference data to the wireless sensor reader.

82. The method of claim 77, further comprising the step of communicating sensor processing information to the wireless sensor reader.

83. The method of claim 80, wherein communicating the digital sensor data to the wireless sensor reader includes communicating the digital sensor data as a component of the tag identification number.

84. A sensor network for monitoring for the presence of hazardous agents within a geographic area, comprising:

- one or more RF addressable sensors wherein each RF addressable sensor includes at least one sensor element for detecting the presence of a hazardous agent;

- one or more wireless sensor readers coupled to a communications network, wherein the wireless sensor readers obtain sensor data from the one or more RF addressable sensors; and

- a centralized sensor network processor coupled to a communications network, wherein the centralized sensor network processor receives sensor data from the one or more wireless sensor readers.

85. The sensor network of claim 84, wherein at least one of the one or more RF addressable sensors is capable of detecting the presence of a chemical agent.

86. The sensor network of claim 85, wherein at least one of the one or more RF addressable sensors is capable of detecting the presence of a radiological agent.

87. The sensor network of claim 86, wherein at least one of the one or more RF addressable sensors is capable of detecting the presence of a biological agent.

88. A method for monitoring a geographic area for the presence of hazardous agents, the method comprising:

(a) distributing a plurality of RF addressable sensors over a geographic area;

(b) deploying one or more wireless sensor readers within the geographic area to read the plurality of RF addressable sensors;

(c) at each wireless sensor reader,
initiating a read of the one or more RF addressable sensors,
receiving sensor data from the one or more RF addressable sensors, and

communicating the received sensor data to a centralized network sensor processor;

(d) determining whether the sensor data indicates the presence of a hazardous agent; and

(e) if it is determined that the sensor data indicates the present of a hazardous agent, performing geolocation to identify the location of the RF addressable sensor that communicated the sensor data.

89. A sensor network for the remote monitoring of shipping containers, comprising:

one or more packages, wherein each package includes one or more RF addressable sensors;

one or more shipping containers, wherein the one or more packages are loaded onto at least one of the one or more shipping containers for transport;

at least one transport vessel having a device for receiving sensor data from a wireless sensor reader; and

a centralized network monitoring processor for performing risk management on the received sensor data,

wherein each shipping container includes one or more wireless sensor readers, wherein the wireless sensor readers obtain sensor data from the one or more RF addressable sensors, and

wherein each RF addressable sensor includes at least one sensor element for detecting the presence of a hazardous agent.

90. The sensor network of claim 89, wherein the centralized network monitoring processor includes logic for performing geolocation.

91. The sensor network of claim 90, wherein each shipping container includes one or more RF addressable sensors.

92. The sensor network of claim 89, further comprising one or more shipping boxes.

93. A sensor network for the remote monitoring of one or more individuals, comprising:

- one or more smart cards transported by at least one individual, wherein each smart card includes one or more RF addressable sensors;

- at least one wireless sensor reader coupled to a communications network; and

- one or more end user devices for remotely initiating a read of the RF addressable sensors over the communications network,

- wherein the at least one wireless sensor reader communicates with the one or more RF addressable sensors to obtain sensor data to communicate over the communications network, and

- wherein an individual has at least one smart card.

94. The sensor network of claim 93, wherein the smart card is positioned such that the one or more RF addressable sensors are proximate to the skin of the at least one individual.

95. The sensor network of claim 93, further comprising a centralized diagnostic system for initiating a read of the RF addressable sensors and processing the received sensor data to identify changes requiring attention of a health care professional.

96. A sensor network for monitoring of the contents of an appliance, comprising:

- one or more items placed in the interior of the appliance;

- one or RF addressable sensors coupled to each item;

one or more wireless sensor readers located within a read range of the RF addressable sensors and coupled to a communications network; and

an end-user device coupled to the communications network for initiating a read of the RF addressable sensors.

97. A sensor network for monitoring structures, comprising:

one or more RF addressable sensors wherein the RF addressable sensors are proximate to the support members of the structure;

one or more wireless sensor readers coupled to a communications network, wherein the wireless sensor readers obtain sensor data from the one or more RF addressable sensors; and

a centralized sensor network processor coupled to the communications network, wherein the centralized sensor network processor receives sensor data from the one or more wireless sensor readers over a communication network.

98. The sensor network of claim 97, wherein the RF addressable sensors include a sensor element for measuring structural stress.

99. A method in a wireless sensor reader for obtaining sensor data from one or more radio frequency (RF) addressable sensors, comprising:

transmitting signals to the one or more RF addressable sensors wherein the signals initialize the one or more RF addressable sensors;

interrogating the one or more RF addressable sensors to isolate an individual RF addressable sensor;

receiving sensor data from the isolated RF addressable sensor, wherein the received sensor data includes sensor identification information;

communicating sensor identification information to a processor external to the wireless sensor reader;

receiving sensor data processing information; and

processing the sensor data based on the received processing information.

100. The method of claim 83 wherein the received sensor processing information includes software for analyzing the received sensor data.

101. A method in a wireless sensor reader for obtaining sensor data from one or more radio frequency (RF) addressable sensors, comprising:

transmitting signals to the one or more RF addressable sensors, wherein the signals initialize the one or more RF addressable sensors;

interrogating the one or more RF addressable sensors to isolate an individual RF addressable sensor;

receiving sensor data from the isolated RF addressable sensor, wherein the received sensor data includes sensor processing information; and

processing the sensor data based on the received processing information.

102. The method of claim 101 wherein the received sensor processing information includes software for analyzing the received sensor data.

103. An radio frequency (RF) addressable sensor comprising:

one or more sensor elements;

a sensor interface having an analog to digital converter coupled to the one or more sensor elements;

at least one antenna;

an RF power and communication interface coupled to the at least one antenna and the sensor interface;

a controller coupled to the RF power and communications interface and the sensor interface; and

a memory coupled to the controller and the sensor interface, wherein the memory is configured to store a tag identification number;

wherein the sensor interface includes a memory, the memory including a sensor data table.